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PATENT APPLICATION

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UNITED STATES PATENT AND TRADEMARK OFFICEInventor(s): Yasushi Saito et al.
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Filing Date: December 1, 2003Confirmation No.: 2665
Examiner: Brent S. Stace
Group Art Unit: 2161

Title: NAMESPACE CONSISTENCY FOR A WIDE AREA FILE SYSTEM

Mail Stop Appeal Brief - Patents
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Alexandria, VA 22313-1450TRANSMITTAL OF REPLY BRIEFTransmitted herewith is the Reply Brief with respect to the Examiner's Answer mailed on May 8, 2008.

This Reply Brief is being filed pursuant to 37 CFR 1.193(b) within two months of the date of the Examiner's Answer.

(Note: Extensions of time are not allowed under 37 CFR 1.136(a))

(Note: Failure to file a Reply Brief will result in dismissal of the Appeal as to the claims made subject to an expressly stated new ground rejection.)

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Typed Name: Derek J. Westberg

Signature: 

Respectfully submitted,

Yasushi Saito et al.

By 

Derek J. Westberg

Attorney/Agent for Applicant(s)

Reg No.: 40,872

Date: July 7, 2008

Telephone: (650) 968-0410

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor:
Yasushi Saito

Examiner: Brent S. Stace

Serial No. 10/726,041

Art Unit: 2161

Filed: December 1, 2003

Confirmation No. 2665

Entitled: NAMESPACE
CONSISTENCY FOR A WIDE
AREA FILE SYSTEM

REPLY BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir/Madame:

Sir/Madame:

This is Applicant's reply brief on appeal from the final office action mailed on June 8, 2007. This reply brief is organized in accordance with the suggested format set forth in Section 1208 of the Manual of Patent Examining Procedure (8th Ed. Sept. 2007).

Atty. Dkt. No. 200300598-1**Status of Claims**

Claims 1-15 and 56-69 are pending in this application. Claims 1-15 and 56-69 have been finally rejected and are the subject of this appeal.

Atty. Dkt. No. 200300598-1**Grounds of Rejection to be Reviewed on Appeal**

Whether the drawings are properly objected to under 37 C.F.R. 1.84(p)(5) as including the reference character "405" which is allegedly not mentioned in the description.

Whether claims 11 and 59-69 are unpatentable under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite.

Whether claims 1, 10 and 11 are unpatentable under 35 U.S.C. § 103 as allegedly being obvious over "Replication in Ficus Distributed File Systems," by Popek et al. (hereinafter "Popek") in view of U.S. Patent Publication No. 2001/0044879 by Moulton, et al. (hereinafter, "Moulton").

Whether claims 2-9 and 56-66 are unpatentable under 35 U.S.C. § 103 as allegedly being obvious over Popek in view of Moulton and further in view of "Designing a Robust Namespace for Distributed File Services" by Zhang et al. (hereinafter, "Zhang").

Whether claim 12 is unpatentable under 35 U.S.C. § 103 as allegedly being obvious over Popek in view of Moulton and further in view of "The Costs and Limits of Availability for Replicated Services" by Yu et al. (hereinafter, "Yu").

Whether claims 13 and 15 are unpatentable under 35 U.S.C. § 103 as allegedly being obvious over Popek in view of Moulton and further in view of U.S. Patent Publication No. 2002/0107835 by Coram et al. (hereinafter, "Coram").

Whether claims 14 and 67-69 are unpatentable under 35 U.S.C. § 103 as allegedly being obvious over Popek, Moulton and Coram, and further in view of Zhang.

Atty. Dkt. No. 200300598-1**Argument**

In the interest of brevity, Applicants do not attempt to address every point made in the Examiner's Answer. Rather, the Applicants address below what are believed to be the most significant errors. For all maintained rejections, including those not specifically discussed in this Reply Brief, the Applicants continue to request reversal for the reasons given in Applicants' Appeal Brief.

a. Rejections under 35 U.S.C. § 103 in view of Popek and Moulton

Claim 1

Claim 1 was rejected under 35 U.S.C. § 103 as allegedly being obvious over Popek in view Moulton. The body of the Examiner's Answer repeats many of the arguments made in the final rejection. See, Examiner's Answer mailed on May 8, 2008, at pages 4-6. The Applicants have fully addressed those arguments in the Applicants' Appeal Brief. See, Applicants' Appeal Brief at pages 15-21. The Examiner's Answer also includes a section entitled, "Response to Argument." See, Examiner's Answer mailed on May 8, 2008, at pages 16-33. The Applicants have the following comments regarding the "Response to Argument" section of the Examiner's Answer.

The Applicants previously disagreed with the Examiner's suggested reason for making the combination of Popek and Moulton - that both are directed toward replicating files "across" computers. This because Moulton is directed toward breaking a single data element into pieces and storing the pieces "across" multiple nodes, whereas, Popek is directed toward replication in the Ficus distributed file system. See, Title of Popek. Therefore, because Popek does not store files "across" nodes in the manner of Moulton,

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the Applicants respectfully disagree with this alleged motivation. The Applicants also explained that Popek clearly discusses that concepts taken from the field of databases and transaction-based data storage systems are not applicable to distributed file systems, such as the one described by Popek. See, Popek at page 23. However, Moulton describes just such a system. This is apparent because Moulton is not directed toward a distributed file system, but is instead directed toward a "System and Method for *Distributed Data Storage*." See, title of Moulton. Therefore, because Popek teaches that concepts taken from the field of databases and transaction-based data storage systems are not applicable to distributed file systems, and Moulton describes just such a system, Popek teaches away from making a combination of Moulton with Popek.

In response to these arguments, the "Response to Argument" section of the Examiner's Answer states, in part, as follows:

In this case, combining the prior arts offers the obvious advantage of having an efficient means of determining how the replicas replicate (Moulton, paragraphs [0032] and [0036]). In the cited sections of Moulton, Moulton discusses Fig. 1. Fig. 1 of Moulton is a graph of computer nodes in a replication network of Moulton and how the nodes are all connected with each other. As combined, the graph shows the manner of which updates of Popek will go/travel to update other nodes. Without such a graph, it becomes inefficient to determine how replicas and updates to replicas will replicate (the use of a graph can also be seen in Popek, however, on p. 22, col. 2, ¾ down the col.). As such, there is suggestion to combine the references found in the references themselves.

See, Examiner's Answer at pages 16-17. The Applicants previously explained (at page 19 of their Appeal Brief) that at paragraph [0032] Moulton describes the network shown in Figure 1 of Moulton as being the Internet. Therefore, this figure of Moulton does not show a "graph" such that "each replica of the file directory has edges to only a subset of other replicas such that all the replicas of the file directory are connected via the graph," as recited by Applicants' claim 1. Rather, Figure 1 of Moulton shows only network

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"clouds," including an Internet Backbone 102, WANs and LANs, connecting network nodes 105 and storage mechanisms 106. Therefore, Figure 1 of Moulton does not disclose any edges among the nodes, but instead merely shows abstract clouds. Further, at paragraph [0036] Moulton explains that storage nodes 105 and storage management mechanisms 106 are merged in the sense that both are implemented at each node 105/106. Thus, the Applicants respectfully submit that these portions of Moulton are unrelated to the alleged motivation of having an "efficient means of determining how the replicas replicate." The Popek also does not provide such a motivation either. For example, Popek at page 22, col. 2, which is relied upon in the quotation from the Examiner's Answer above, uses the term "graph" to refer to a directory structure, not to a manner of propagating updates. Therefore, the Applicants respectfully submit that the alleged motivation of having an "efficient means of determining how the replicas replicate" would not have motivated a person of ordinary skill to combine Popek with Moulton in a manner which would achieve the Applicants' claimed invention. Rather, the Applicants respectfully submit that the motivation to combine the references instead comes from the Applicants' own disclosure since it is the Applicants that describe the use of a graph for propagating updates. However, the Applicants' own disclosure cannot properly be used to support a rejection under 35 U.S.C. § 103.

The "Response to Argument" section of the Examiner's Answer also argues as follows:

The Appellant's further argue that Popek and Moulton are not analogous arts because Popek allegedly teaches that "concepts taken from the field of databases and transaction-based data storage systems are not applicable to distributed file systems." Appellant's then at least imply that Moulton includes concepts taken from the field of databases and transaction-based data storage systems. However, Moulton is concerned with different ways of replicating files over a network and

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accessing the replicated, much like Popek. Moulton does not depend on a database to do this or any kind of transaction model/ transaction-based data storage system. As such Popek and Moulton appear to be readily combinable/modifiable for the rejections above.

See, Examiner's Answer at page 17. The Examiner's Answer, therefore, argues essentially that despite the clear teaching away from the combination by Popek, it would have been obvious to make the combination because the references are "combinable/modifiable." The Applicants respectfully disagree. Even assuming that the references can be combined or modified, this does not mean that it would have been obvious to do so. Rather, as explained above, the clear teaching away contained in Popek renders the combination not obvious.

The "Response to Argument" section of the Examiner's Answer additionally argues as follows:

With respect to the Appellant's argument with respect to Claims 1 (and 56) for the prior art(s) allegedly not teaching "a plurality of nodes storing replicas of objects, the object being files and file directories, wherein for each replica of an object at a node, a parent directory for the object is replicated at the node," the examiner respectfully disagrees. Popek, page 22, 1st paragraph under "5 The Ficus Project" was used to reject this limitation above. In the cited section, Popek teaches:

"The system permits one to replicate files selectively within limits set by administrative control. That is, a collection of the file volume replicas are set up at various storage sites for a given logical file subtree. A given file may be replicated at any subset of the sites hosting a volume replica."

This citing teaches that files are replicated from "volume replicas." As such, these volumes hold files and at the very least can be considered folders (a.k.a. directories) containing files. Also, Popek, p. 21, paragraph 4 under "3 The Optimistic model" discussed the existence of a "directory system" in Ficus. These directories in Ficus are known to hold files (Popek, abstract, and knowledge generally known in the art). The volume alone can be considered a directory, the directories alone can be considered directories, or the directories in the volumes can be considered as a plurality of directories (with the volume being a parent directory of an object/file). These volume replicas with their files/file directories are the claimed objects being files and file directories. The replicas are set up at various storage sites. These storage sites are the claimed plurality of nodes storing

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replicas. The storage sites hosting the volume replicas means that the volume (folder/files) are copied/replicated at the node/storage site (for each storage site set up to host a volume replica). As such, a parent directory (volume) for the object (file within the volume) is replicated at the node (storage site). It should be noted that Popek also explicitly teaches directories on Popek, p. 21, last paragraph. However, Popek teaches the claimed invention as claimed:

See, Examiner's Answer at pages 17-19. The Applicants respectfully submit that this argument fails to meet the burden of showing where in Popek each of the claim limitations are alleged to have be taught either explicitly or inherently. Instead, this argument relies upon extensive interpretation and reading into Popek to find the claim limitations which are allegedly taught. For example, the Examiner states that "volume replicas" discussed by Popek can "at the very least" be considered "folders" which the Examiner then interprets as being another term for "directories." However, this chain of reasoning is unsupported. The Applicants continue to maintain that Popek fails to disclose, either explicitly or inherently, "a plurality of nodes storing replicas of objects, the objects being files and file directories, wherein for each replica of an object at a node, a parent directory for the object is replicated at the node," as required by Applicants' claim 1.

The "Response to Argument" section of the Examiner's Answer further argues as follows:

With respect to the Appellant's argument with respect to Claims 1 (and 56) for the prior art(s) allegedly not teaching "propagating an update to a replica of a file directory to other replicas of the file directory via a graph, wherein each replica of the file directory has edges to only a subset of other replicas such that all the replicas of the file directory are connected via the graph," the examiner respectfully disagrees. Popek, page 21, 1st and 3rd paragraphs under "3 The Optimistic Model" was used to teach the propagation of updates with Moulton, Fig. 1 mostly teaching the graph and the properties of the graph. Popek, page 21, 1st and 3rd paragraphs under "3 The Optimistic Model" teaches "... allow update to occur in at most one connected environment. Then propagate that update to other storage sites when communication is re-established." And "When multiple copies

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were re-connected, if any were out of date, the new version would be automatically propagated to make them current." Popek explicitly teaches propagating updates to other storage sites/nodes. These nodes, containing volume replicas (file directories) are seen as propagating updates to replicas of a volume/file directory to other replicas of the file directory. Popek does not go into detail explicitly how this is done, however, Moulton's graph can be applied to Popek's update propagation seeing that both inventions are dealing with networked computers, and therefore make a graph like Moulton, Fig. 1. Moulton, Fig. 1, shows a graph of networked nodes (details 105/106) connected by Local Area Networks (LANs, 104) and Wide Area Networks (WANs 103) and the Internet (102). The graph of Moulton is being overlaid onto the invention of Popek such that the network in Popek looks like Moulton's network of Fig. 1. As such, the nodes in Moulton are Popek's storage sites. As can be seen in Moulton, Fig. 1, each replica of the file directory (node storing volume replica) has edges to only a subset of other replicas (e.g. edges only via LAN cloud 104 from node 105 to 105 or 106 within the LAN) such that all the replicas of the file directory (nodes storing volume replica) are connected via the graph (all nodes are eventually connected through the clouds in the graph). As such, the combination of reference teach the claimed limitations as claimed.

See, Examiner's Answer at page 19-20. This argument relies upon "volume replicas" of Popek as being equivalent to "file directories." As explained above, the Examiner's Answer lacks support for this assertion. This argument also relies upon Figure 1 of Moulton as allegedly teaching "each replica of the file directory has edges to only a subset of other replicas such that all the replicas of the file directory are connected via the graph," as recited by Applicants' claim 1. As explained at page 20 of Applicants' Appeal brief, it necessarily follows from claim 1 that some replicas of file directories are directly connected by an edge, whereas, other replicas are only indirectly connected via one or more intermediate replica-holding nodes. Updates are propagated along the graph. Therefore, it also necessarily follows from claim 1 some updates to the replicas of the file directories are propagated directly from one replica to another, whereas, other updates to the replicas of the file directories are propagated via the one or more intermediate replica-holding nodes. However, Figure 1 of Moulton "shows an exemplary internetwork

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environment 101 such as the Internet." See Moulton at paragraph [0032], lines 2-3. Figure 1 of Moulton shows only network "clouds," including an Internet Backbone 102, WANs and LANs, connecting network nodes 105 and storage mechanisms 106. Therefore, Figure 1 of Moulton does not disclose any edges among the replicas, nor direct or indirect connections among replicas. Instead, Figure 1 of Moulton merely shows abstract "clouds." Because Figure 1 of Moulton does not disclose edges among the nodes, it cannot disclose the particular configuration of edges and nodes which are recited in Applicants claim 1. Particularly, Moulton does not disclose "each replica of the file directory has edges to only a subset of other replicas such that all the replicas of the file directory are connected via the graph," as recited by Applicants' claim 1.

In view of the above, the Applicants continue to respectfully request reversal of the rejection of claim 1.

Claim 10

Regarding claim 10, the "Response to Arguments" section of the Examiner's

Answer argues as follows:

With respect to the Appellant's argument with respect to Claims 10 and 65 for the prior art(s) allegedly not teaching "wherein the replicas of the file directory include core replicas and non-core replicas, the parent directory for the file directory having edges to only to the core replicas of the file directory and each core replica of the file directory having edges to one or more of the non-core replicas of the file directory," the examiner respectfully disagrees. Moulton, paragraphs [0028] and [0078] was used to best teach these claims. First, the examiner would like to discuss the interpretations of the claim. The examiner, in light of the specification (page, 26-27, lines 10-5), interprets core replicas as being replicas from which other replicas are made from, while non-core replicas are replicas made from core replicas. This interpretation appears to be a supported interpretation in the Appellant's specification (page, 26-27, lines 10-5). Moulton, paragraph [0078] teaches "In operation, every data write operation is executed to the primary node an all mirror nodes." This teaching shows that Moulton holds a

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node as being primary, while other nodes are mirror nodes. The primary node (inherently holding data like that of Popek (and can be seen in Moulton, paragraph [0078] reciting "primary image")) is the claimed "core replica" while the mirror nodes are the non-core replicas. The primary node nodes copies/replicas of objects across the network. As such, "replicas of the file directory include core replicas." The mirror nodes also hold replicas of the objects, and they are "replicas of the file directory include... non-core replicas." When an update occurs in Popek, the replica that originates the update (and propagates the update) is seen as a core replica since it is the replica from which other replicas are made. According to Fig. 1 of Moulton then, the update would propagate from one computer to another via the various networks (edges) available. As such, edges can be seen from a parent directory for the file directory having edges to only the core replicas of the file directory (the core update is propagated to non-core computers in the network via edges). Additionally, each core replica of the file directory has edges to one or more of the non-core replicas of the file directory since the core update has to be propagated to other replicas for file/directory consistency.

See, Examiner's Answer at page 20-22. The Applicants respectfully disagree with this reasoning. Both the core replicas and the non-core replicas recited by Applicants' claim 10 are replicas of file directories. Thus, claim 10 recites two different types of replicas of file directories and a particular manner in which these different types of file directories are connected, namely, that the parent directory for a file directory has edges only to the core replicas of the file directory and each core replica of the file directory has edges to one or more of the non-core replicas of the file directory. At paragraph [0028], Moulton merely discusses that nodes are located on LANs, MANs and WANs and that the nodes are internetworked using mechanisms such as the Internet. At paragraph [0078], Moulton discusses that data elements can be mirrored such that every data write operation is executed to the primary node and all mirror nodes. Therefore, the Applicants respectfully submit that the relied-upon passages of Moulton do not disclose the particular types of file directory replicas, nor the particular manner in which these file directory replicas are

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connected, as recited by Applicants' claim 10. Popek does not disclose these features either.

In view of the above, the Applicants continue to respectfully request reversal of the rejection of claim 10.

Claim 11

Regarding claim 11, the "Response to Arguments" section of the Examiner's Answer argues as follows:

With respect to the Appellant's argument with respect to Claims 11 and 66 for the prior art(s) allegedly not teaching "wherein in response to a user accessing an object at a node when no replica of the object exists at the node, the method further comprises the steps of forming a non-core replica of the parent directory for the object at the node and forming a non-core replica of the object at the node," the examiner respectfully disagrees. Moulton, paragraph [0078] was used to reject this limitation. The cited section in Moulton teaches "Read operations attempt to first read the data from one of the nodes, and if that node is unavailable, a read from the mirror node is attempted." This teaches the reading method of Moulton (a user attempted to access an object at a node) that when a node is unavailable (when no replica exists) a non-core replica of the object and the object's parent directory will be created at the node. Moulton paragraph [0078] teaches about RAIN level 1 (similar to RAID level 1, but instead of being across storage devices it is across networked nodes). RAIN level 1 (and RAID level 1) guarantee mirroring of data between nodes (for RAIN) (while RAID is between storage devices). As such, when a replica is non-existent/not available, the system must recover from this failure in order to guarantee mirroring of data (Moulton [0078] teaches that RAIN level 1 "offers high reliability" and Moulton [0039] teaches that RAIN has fault tolerance and the ability to recover from such faults. As such, Moulton (with the prior modifications from Popek) teach the claimed limitations as claimed.

See, Examiner's Answer at page 20-22. The Applicants respectfully disagree with this reasoning. As observed in the quotation above, Moulton teaches at paragraph [0078] that "Read operations attempt to first read the data from one of the nodes, and if that node is unavailable, a read from the mirror node is attempted." In other words, Moulton teaches

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that if a node is unavailable for a read operation, the read operation is attempted at a different node. This does not disclose Applicants' claim 11 at least because claim 11 requires that if no replica of a particular object exists at a particular node, then a replica of the object is formed at that same node.

In view of the above, the Applicants continue to respectfully request reversal of the rejection of claim 11.

b. Rejections under 35 U.S.C. § 103 in view of Popek, Moulton and Zhang

Claim 2

Regarding claim 2, the "Response to Arguments" section of the Examiner's

Answer argues, in part, as follows:

Even though Zhang appears to be directed toward distributed file services, Zhang has support (in a foot note on p. 2) for a replication service. Additionally, Zhang, p. 1, col. 2, lines 2-3 describe that DiFFS objects can be replicated (for a replication distributed file service), and Zhang, p. 1, col. 2, 2nd to last paragraph states that "this report is to investigate protocols for building robust namespaces in the context of DiFFS. As such there is support for why one of ordinary skill in the art would look to Zhang to combine with Popek and Moulton. Also, as can be seen above, Zhang is at least reasonably pertinent to the particular problem with which the Appellant is concerned (consistency). Also, there is suggestion that Zhang is in the field of Appellant's endeavor and is reasonably pertinent to the particular problem with which the Appellant is concerned since an author of the Zhang reference is one of the inventors for the instant application (Christos Karamanolis). As such, Zhang is analogous prior art.

See, Examiner's Answer at pages 23-24. The Applicants respectfully disagree with this reasoning. While Zhang discloses a "backpointer" in connection with distributed file services and Zhang also separately mentions replication, Zhang does not teach or suggest the use of a backpointer in a system in which files and file directories are replicated, nor does Zhang teach or suggest how such a backpointer might be employed in a such

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system. Moreover, the Applicants respectfully submit that the circumstance that an author of the Zhang reference is also an Applicant of the present application does not in any way support the conclusion that the present invention would have been obvious to a person of ordinary skill in the art in view of the Zhang reference. Just as the Applicants' own disclosure cannot be used to support a finding of obviousness, the identities of the Applicants also cannot be used to support a finding obviousness.

Claim 3

Regarding claim 3, the "Response to Arguments" section of the Examiner's Answer argues as follows:

With respect to the Appellant's argument with respect to Claims 3, 9, 58, and 64 for the Zhang allegedly not suggesting "any actions that might be taken to detect whether there are inconsistencies among replicas of file or file directory, nor any actions that might be taken [in] response to detection of such an inconsistency," the examiner respectfully submits that this is not claimed subject matter in Claims 3, 9, 58, or 64. In pursuing compact prosecution, the examiner will not entertain arguments relating to not claimed subject matter. It should be noted that the Appellant has not argued subject matter of Claims 3, 9, 58, or 64 in the appeal brief. The Appellants have only submitted that Claims 3 and 58 are allegedly allowable at least because it depends from allegedly allowable claims 1 and 2 and 56, respectfully.

See, Examiner's Answer at page 24. The Applicants respectfully disagree with this reasoning. Claim 3 recites as follows: "The method according to claim 2, wherein the parent directories are modified when the backpointer for a replica of an object at a node is not consistent with the parent directories for the replica of the object at the node." Therefore, claim 3 does indeed recite an action (modifying parent directories) that is taken in response to detection of an inconsistency. The Applicants respectfully continue to maintain that Zhang does not disclose the limitations of Applicants' claim 3.

Atty. Dkt. No. 200300598-1Claim 4

Regarding claim 4, the "Response to Arguments" section of the Examiner's

Answer argues as follows:

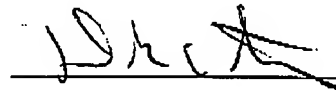
With respect to the Appellant's argument with respect to Claims 4 and 59 for the prior art(s) allegedly not teaching "a delay," the examiner respectfully disagrees. As can be seen throughout all the references, the references rely on networked computers. Sending data between computers always incurs a delay due to a numbers of factors (e.g. processing power of the computers, network latency etc.). Even if the prior art(s) were implemented in real time and on one computer, electrical signals can only travel at (at most) the speed of light. This incurs delays of fractions of seconds. Either way, at least a delay is readily apparent since the references are implemented on computers in a computer network.

See, Examiner's Answer at pages 24-25. The Applicants respectfully disagree with this reasoning. Clearly, the delay recited in Applicants' claim 4 will be understood to mean intentional delay and not merely speed-of-light delay which is inherent in all electrical processes. Otherwise, there would have been no purpose to reciting this delay in a dependent claim. Moreover, the claims are to be interpreted in light of the Applicants' specification, which clearly explains this delay as being intentional at least at page 16, line 25, to page 17, line 17.

Atty. Dkt. No. 200300598-1**Conclusion**

In view of the above and in view of the arguments presented in the Applicants' Appeal Brief, the Applicants respectfully submit that all of the pending claims are allowable over the cited art. Accordingly, the Applicants request that the rejections be reversed.

Respectfully Submitted,

Dated: July 7, 2008

Derek J. Westberg (Reg. No. 40,872)